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NASA TECH BRIEF

Goddard Space Flight Center

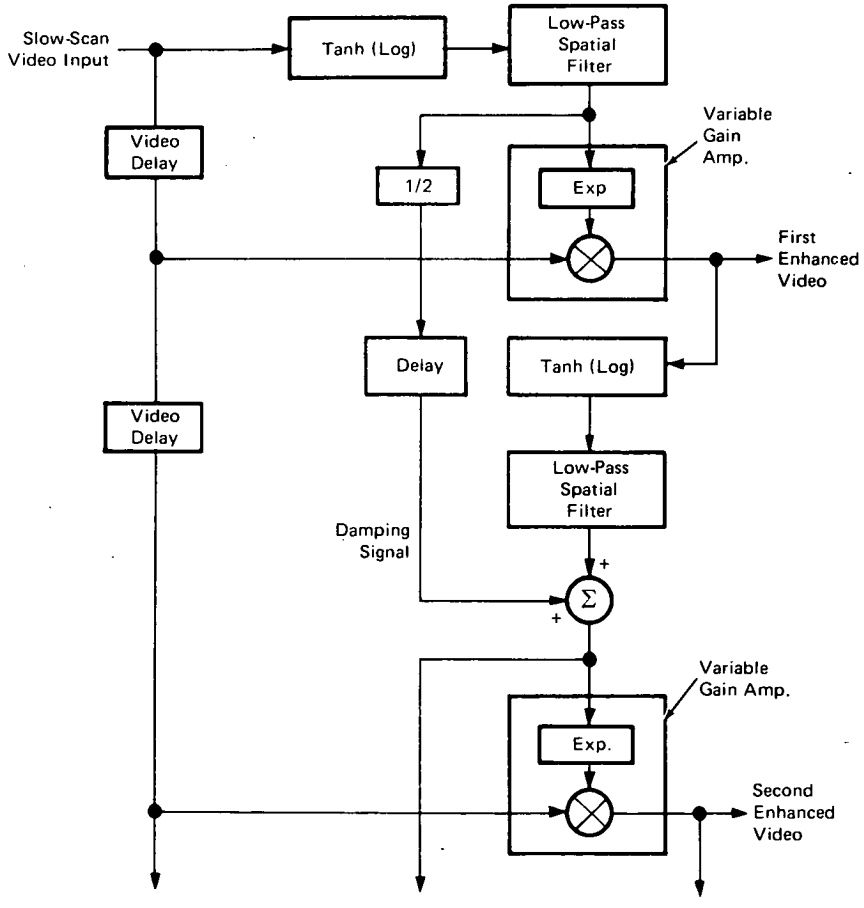
Digital TV Image Enhancement System

The problem:

Standard TV image formats as well as low-resolution slow-scan TV image formats (320 lines, 10 frames/second) are easily handled by the existing analog image enhancement equipment. However, high-resolution slow-scan TV image formats (1280 lines, 5/8 frame/second) require digital image enhancement equipment. One difficulty with the analog image enhancement is that it is subject to registration errors in the scan converter. These errors become more serious as resolution increases. In addition, analog equipment requires several scan fields to reach a steady state. This is undesirable with a slow-scan 5/8 frame/second format.

The solution:

An efficient, digital image-enhancement process has been developed for high-resolution slow-scan TV images.



Feedback Image Enhancement Process for High-Resolution Slow-Scan TV Video

(continued overleaf)

How it's done:

In the system shown, a delayed slow-scan video signal is fed through the variable gain amplifier to produce the first enhanced video signal. This amplifier has the same characteristics as that used in the analog system; thus, its gain is an exponential function of the blurred gain-control signal. The same video signal is also fed through a video delay line, having a time delay equal to that of the low-pass spatial filter. This synchronizes the video signal with the gain control signal which is applied to the variable gain amplifier.

The generation of the first enhanced video signal represents the first cycle of the reiteration process. The second cycle, which generates the second enhanced video, is similar to the first, except for the following: (1) the signal input to the tanh (log) circuit is the enhanced video rather than the input video; and (2) there is a damping signal added to the output of the low-pass spatial filter, to form the blurred gain control signal. This damping signal is half the value of the gain control signal used in the previous cycle. The process can be continued by repeating it in the second cycle, thereby producing a third enhanced video, a fourth enhanced video, etc.

To implement this feedback image enhancement system, digital processing is used; otherwise there is excessive loss of image information, particularly in the video delay lines. For the slow-scan TV signal, such video processing is easily achieved because the signal bandwidth is quite low (500 kHz).

The 500-kHz video signal is digitally processed using a suitable analog-to-digital (A/D) converter along with a sample-hold circuit to provide 1-MHz sampling of eight bits. It is possible to time-share two of these units to achieve 2-MHz sampling. The slow-scan video signal would thus be sampled at a 2-MHz rate, and the video delay lines would operate on digital data. The outputs of these delay lines would be fed to digital-to-analog (D/A) converters to form the video signals fed to the variable gain amplifiers.

The low-pass spatial filters could also be operated digitally. A 1-MHz sampling rate would be more than adequate for these circuits.

Note:

No additional documentation is available. Specific questions, however, may be directed to:

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Patent status:

NASA has decided not to apply for a patent.

Source: George A. Biernson of
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